16A, 50V, 0.047 Ohm, N-Channel Power MOSFETs

The RFD16N05 and RFD16N05SM N-channel power MOSFETs are manufactured using the MegaFET process. This process, which uses feature sizes approaching those of LSI integrated circuits, gives optimum utilization of silicon, resulting in outstanding performance. They were designed for use in applications such as switching regulators, switching converters, motor drivers, and relay drivers. These transistors can be operated directly from integrated circuits.

Formerly developmental type TA09771.

Ordering Information

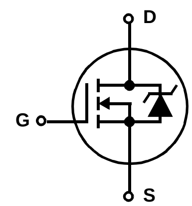
PART NUMBER	PACKAGE	BRAND
RFD16N05	TO-251AA	D16N05
RFD16N05SM	TO-252AA	D16N05

NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-252AA variant in the tape and reel, i.e., RFD16N05SM9A.

Features

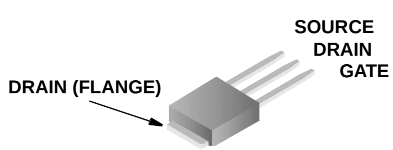
- 16A, 50V
- $r_{DS(ON)} = 0.047\Omega$
- Temperature Compensating PSPICE® Model
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- $175^{o}C$ Operating Temperature
- Related Literature
  - TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"

Symbol

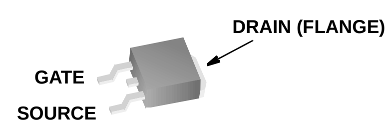


Packaging

JEDEC TO-251AA



JEDEC TO-252AA



Absolute Maximum Ratings $T_C = 25^oC$, Unless Otherwise Specified

		RFD16N05, RFD16N05SM,	UNITS
Drain to Source Voltage (Note 1)	V_{DSS}	50	V
Drain to Gate Voltage (Note 1)	V_{DGR}	50	V
Continuous Drain Current	I_D	16	A
Pulsed Drain Current (Note 3)	I_{DM}	Refer to Peak Current Curve	
Gate to Source Voltage	V_{GS}	±20	V
Pulsed Avalanche Rating	E_{AS}	Refer to Figure 5	
Power Dissipation	P_D	72	W
Derate above 25^oC		0.48	$W/^oC$
Operating and Storage Temperature	T_J, T_{STG}	-55 to 175	^oC
Maximum Temperature for Soldering			
Leads at 0.063in (1.6mm) from Case for 10s	T_L	300	^oC
Package Body for 10s, See Techbrief 334	T_{pkg}	260	^oC

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

1. $T_J = 25^oC$ to 150^oC.

Electrical Specifications $T_C = 25^oC$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage	BV_{DSS}	$I_D = 250\mu A$, $V_{GS} = 0V$ (Figure 11)		50	-	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$, $I_D = 250\mu A$		2	-	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = Rated BV_{DSS}, $V_{GS} = 0V$		-	-	1	μA
		V_{DS} = 0.8 x Rated BV_{DSS}, $V_{GS} = 0V$, $T_C = 150^oC$		-	-	25	μA
Gate to Source Leakage Current	I_{GSS}	$V_{GS} = \pm 20V$		-	-	±100	nA
Drain to Source On Resistance (Note 2)	$r_{DS(ON)}$	$I_D = 16A$, $V_{GS} = 10V$ (Figure 9)		-	-	0.047	Ω
Turn-On Time	$t_{(ON)}$	$V_{DD} = 25V$, $I_D = 8A$, $R_L = 3.125\Omega$, $V_{GS} = 10V$, $R_{GS} = 25\Omega$ (Figure 13)		-	-	65	ns
Turn-On Delay Time	$t_{d(ON)}$			-	14	-	ns
Rise Time	t_r			-	30	-	ns
Turn-Off Delay Time	$t_{d(OFF)}$			-	55	-	ns
Fall Time	t_f			-	30	-	ns
Turn-Off Time	$t_{(OFF)}$			-	-	125	ns
Total Gate Charge	$Q_{g(TOT)}$	V_{GS} = 0V to 20V	$V_{DD} = 40V$, $I_D \approx 16A$, $R_L = 2.5\Omega$ $I_{g(REF)} = 0.8mA$ (Figure 13)	-	-	80	nC
Gate Charge at 10V	$Q_{g(10)}$	V_{GS} = 0V to 10V		-	-	45	nC
Threshold Gate Charge	$Q_{(TH)}$	V_{GS} = 0V to 2V		-	-	2.2	nC
Input Capacitance	C_{ISS}	$V_{DS} = 25V$, $V_{GS} = 0V$, f = 1MHz (Figure 12)		-	900	-	pF
Output Capacitance	C_{OSS}			-	325	-	pF
Reverse Transfer Capacitance	C_{RSS}			-	100	-	pF
Thermal Resistance Junction to Case	$R_{\theta JC}$			-	-	2.083	$^oC/W$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	TO-251 and TO-252		-	-	100	$^oC/W$

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	V_{SD}	$I_{SD} = 16A$	-	-	1.5	V
Diode Reverse Recovery Time	t_{rr}	$I_{SD} = 16A$, $dI_{SD}/dt = 100A/\mu s$	-	-	125	ns

NOTES:

2. Pulse test: pulse width ≤250μs, duty cycle ≤2%.
3. Repetitive rating: pulse width limited by maximum junction temperature. See Transient Thermal Impedance curve (Figure 3) and Peak Current Capability Curve (Figure 5).

Typical Performance Curves Unless Otherwise Specified

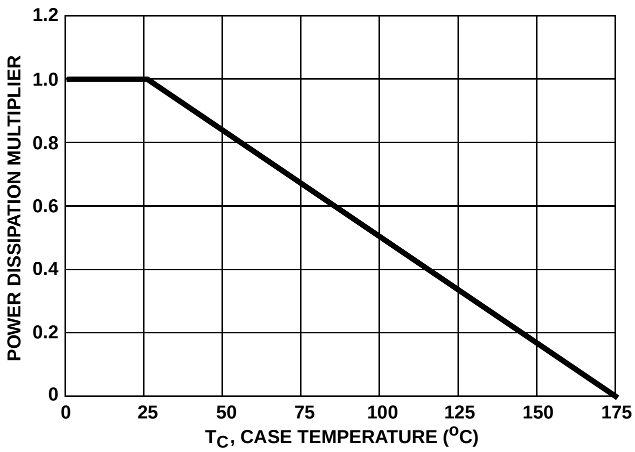


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TENPERATURE

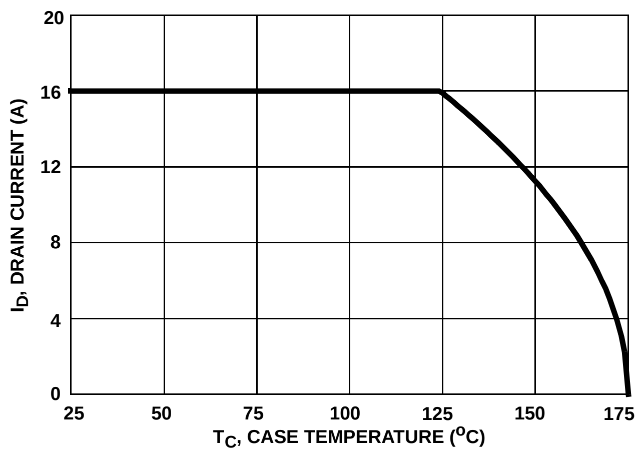


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

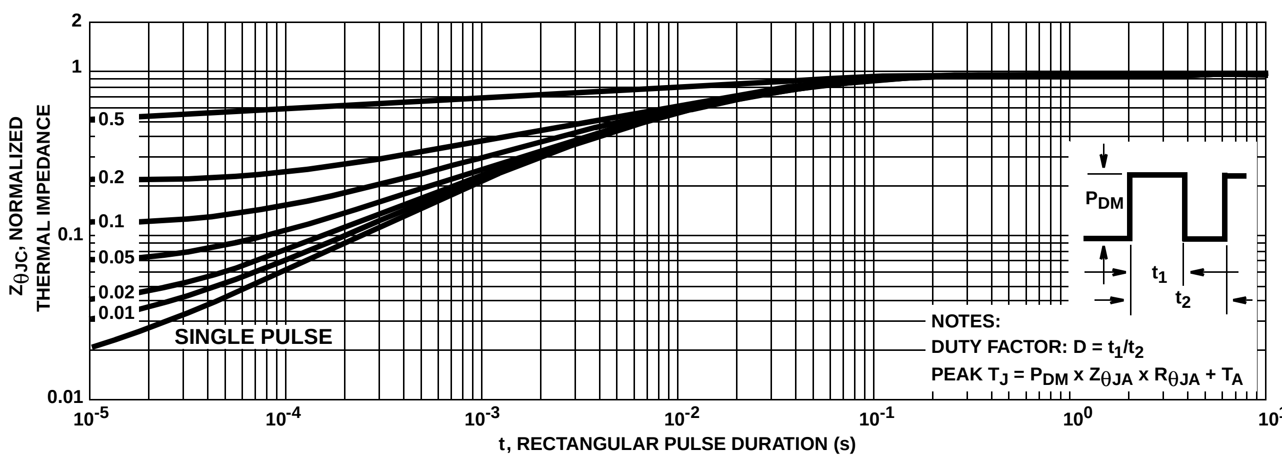


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

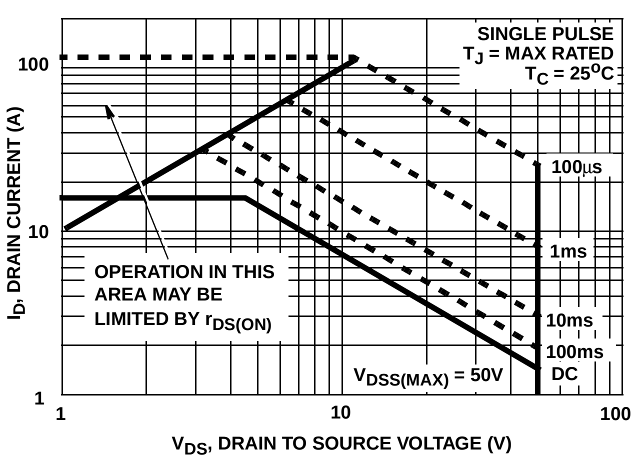


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

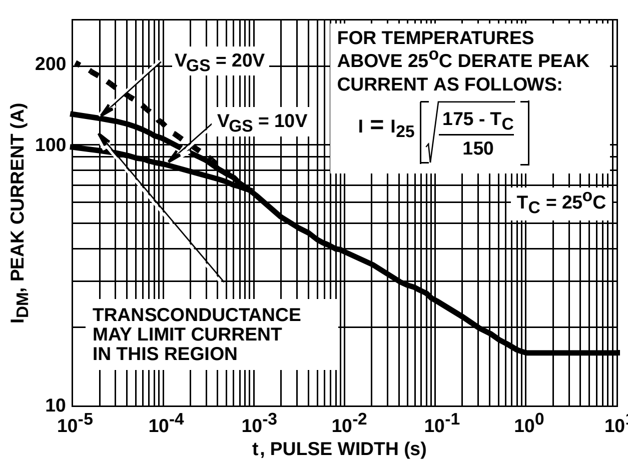
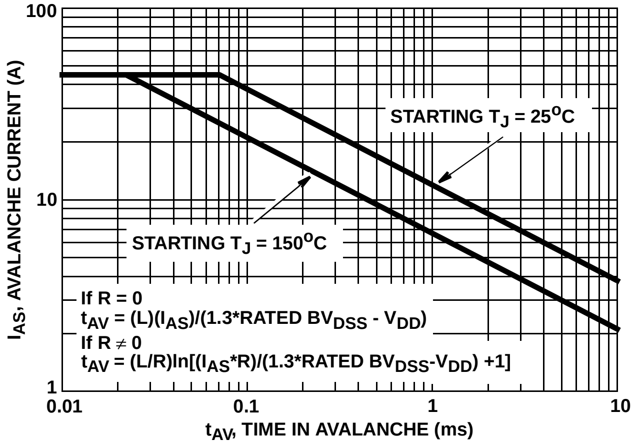


FIGURE 5. PEAK CURRENT CAPABILITY

Typical Performance Curves Unless Otherwise Specified (Continued)



NOTE: Refer to Fairchild Application Notes AN9321 and AN9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING

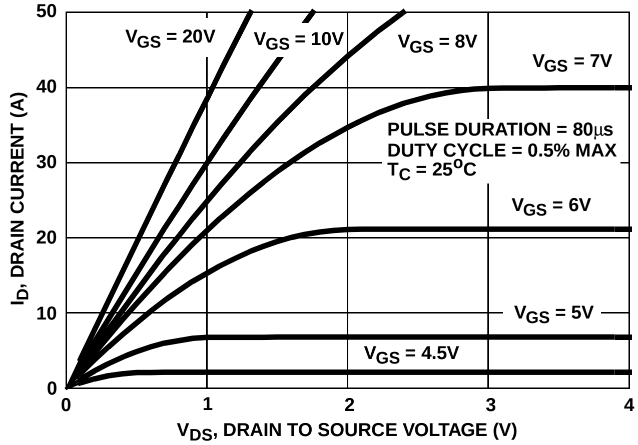


FIGURE 7. SATURATION CHARACTERISTICS

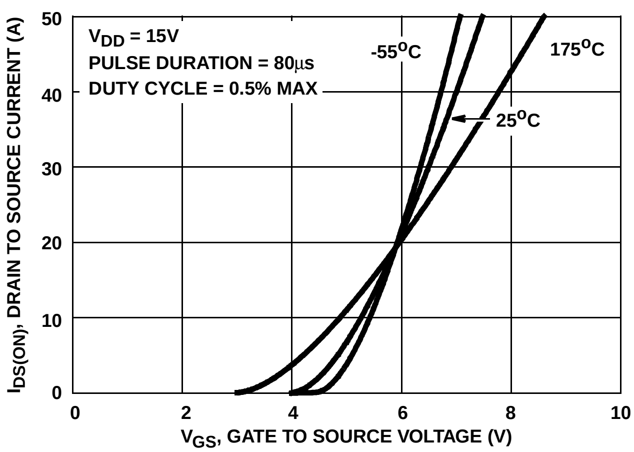


FIGURE 8. TRANSFER CHARACTERISTICS

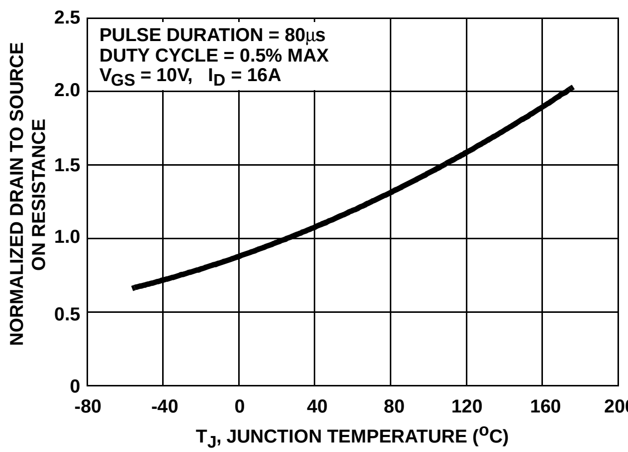


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

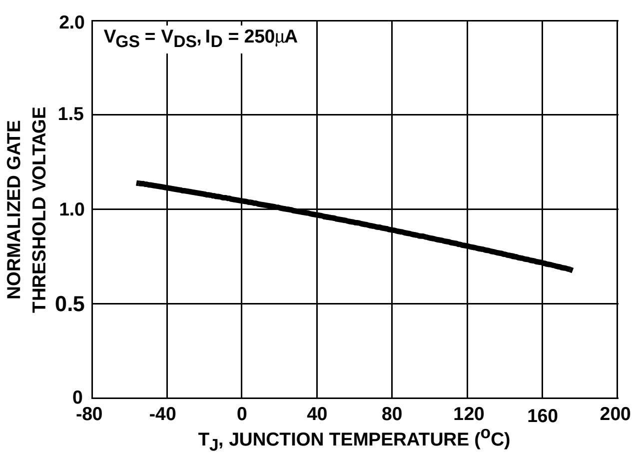


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

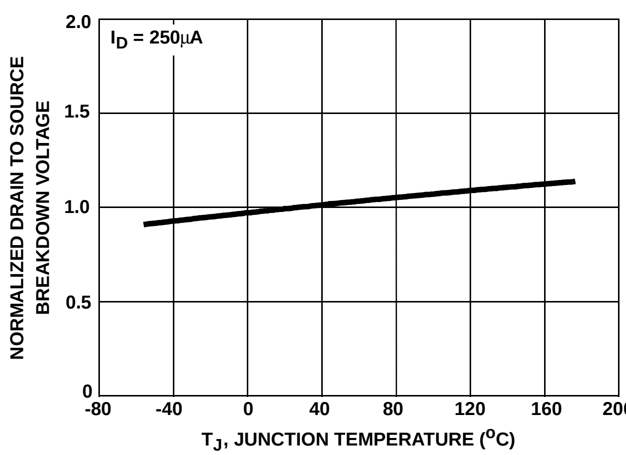


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

Typical Performance Curves Unless Otherwise Specified **(Continued)**

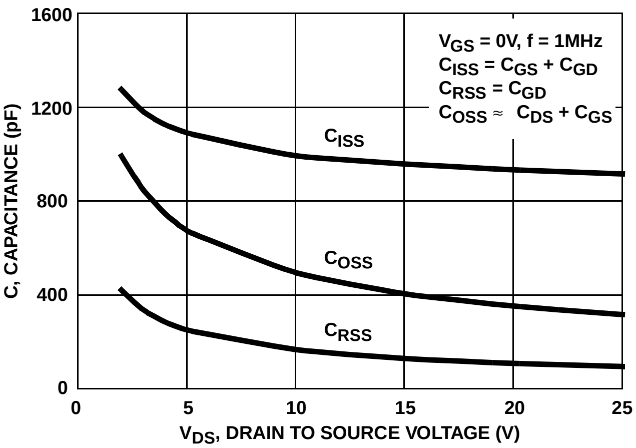
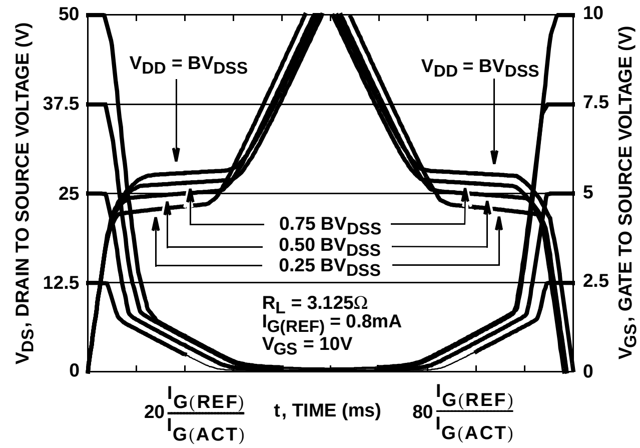


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.

FIGURE 13. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT

Test Circuits and Waveforms

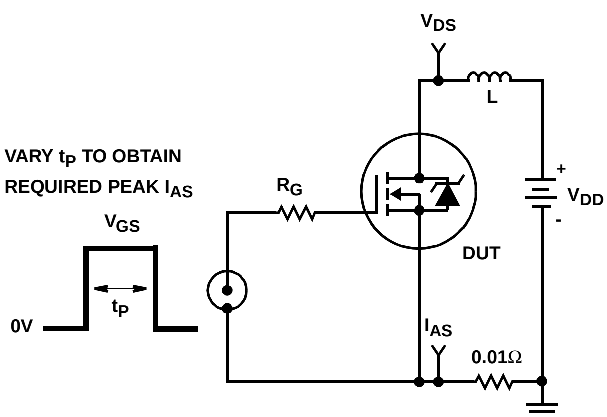


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

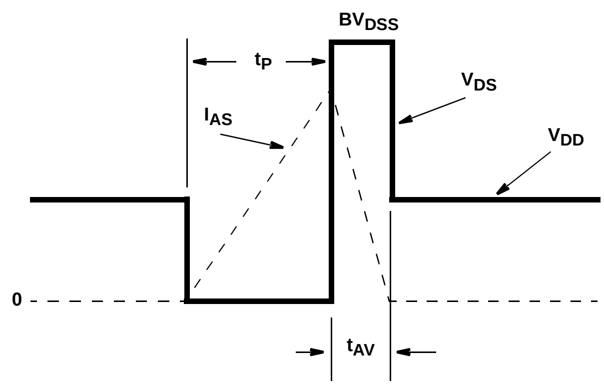


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

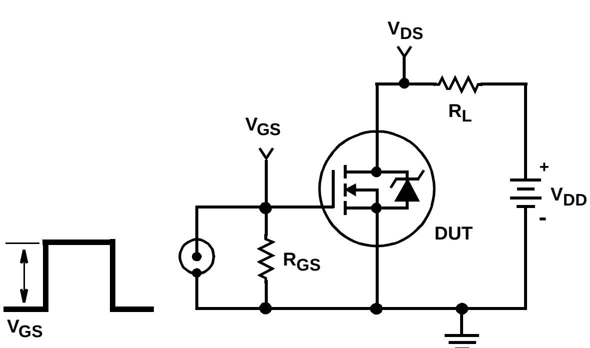


FIGURE 16. SWITCHING TIME TEST CIRCUIT

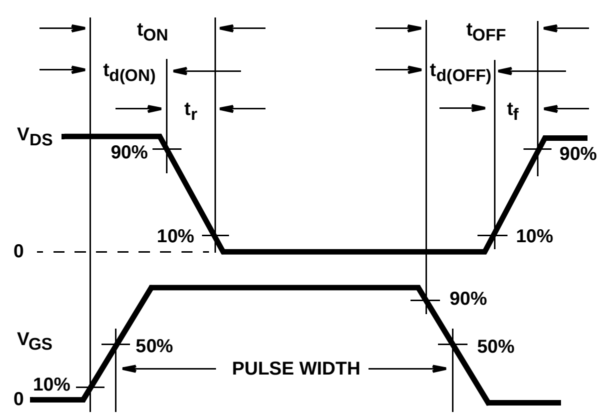


FIGURE 17. RESISTIVE SWITCHING WAVEFORMS

Test Circuits and Waveforms (Continued)

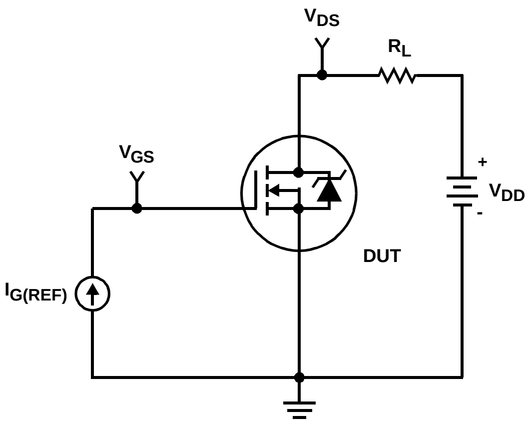


FIGURE 18. GATE CHARGE TEST CIRCUIT

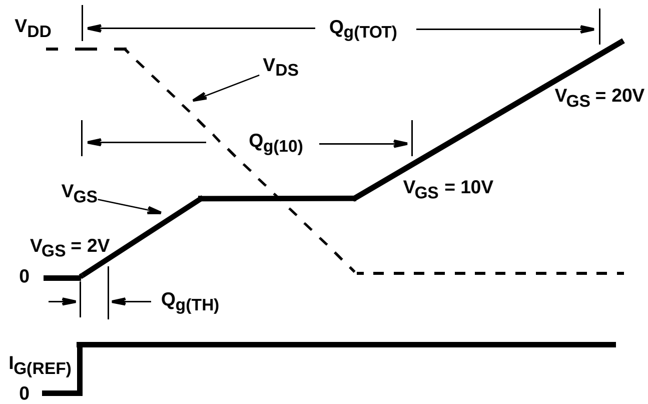


FIGURE 19. GATE CHARGE WAVEFORM

PSPICE Electrical Model

```
.SUBCKT    RFD16N05  2 1 3 ;       rev 10/31/94

CA  12  8  1.788e-10
CB  15  14  1.875e-10
CIN  6  8  8.33e-10

DBODY  7  5  DBDMOD
DBREAK  5 11  DBKMOD
DPLCAP 10  5  DPLCAPMOD

EBREAK  11  7  17  18  64.89
EDS  14  8  5  8  1
EGS  13  8  6  8  1
ESG  6  10  6  8  1
EVTO  20  6  18  8  1

IT  8  17  1

LDRAIN  2  5  1e-9
LGATE 1  9  4.56e-9
LSOURCE  3  7  4.13e-9

MOS1  16  6  8  8  MOSMOD  M = 0.99
MOS2  16  21  8  8  MOSMOD  M = 0.01

RBREAK  17  18  RBKMOD  1
RDRAIN  50  16  RDSMOD  0.4e-3
RGATE  9  20  3.0
RIN  6  8  1e9
RSCL1  5  51  RSCLMOD 1e-6
RSCL2  5  50  1e3
RSOURCE  8  7  RDSMOD  21.5e-3
RVTO  18  19  RVTOMOD  1

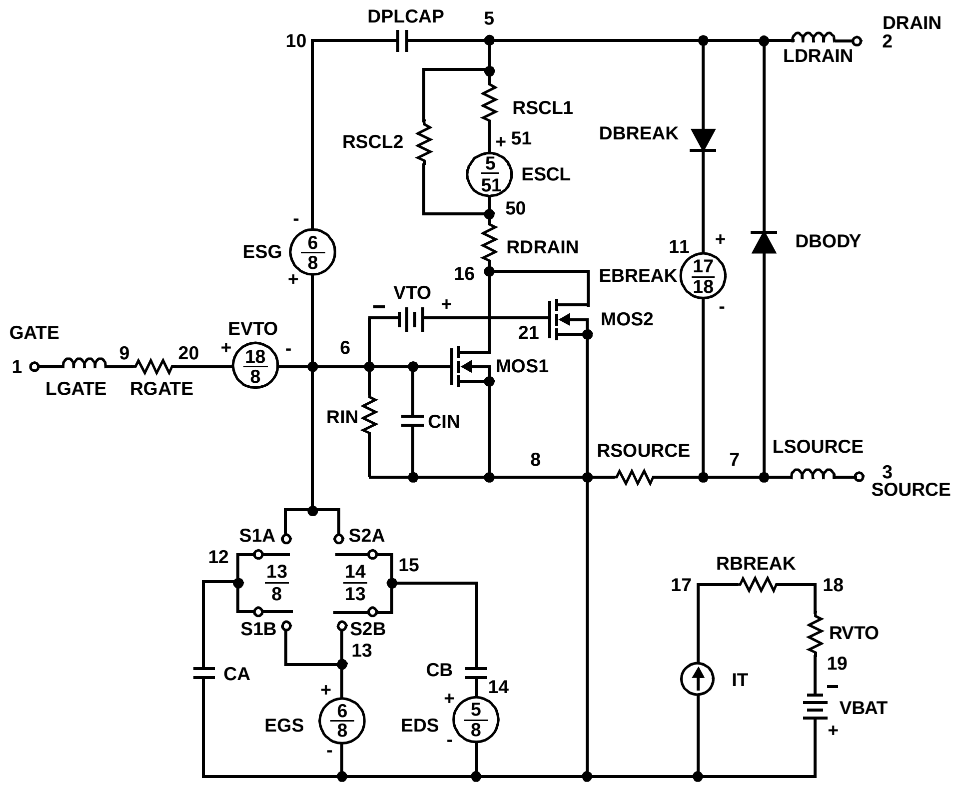
S1A  6  12  13  8  S1AMOD
S1B  13  12  13  8  S1BMOD
S2A  6  15  14  13  S2AMOD
S2B  13  15  14  13  S2BMOD

VBAT  8  19  DC  1
VTO  21  6   0.82

ESCL  51 50  VALUE = {(V(5,51)/ABS(V(5,51)))*(PWR(V(5,51)*1e6/94,7))}

.MODEL DBDMOD D (IS = 2.5e-13  RS = 7.1e-3  TRS1 = 3.04e-3  TRS2 = -10e-6  CJO = 1.12e-9  TT = 5.6e-8)
.MODEL DBKMOD D (RS = 2.51e-1  TRS1 = -6.57e-4  TRS2 = 1.66e-6)
.MODEL DPLCAPMOD D (CJO = 6.1e-10  IS = 1e-30  N = 10)
.MODEL MOSMOD NMOS (VTO = 3.96  KP = 16.68  IS = 1e-30  N = 10  TOX = 1  L = 1u  W = 1u)
.MODEL RBKMOD RES (TC1 = 1.07e-3  TC2 = -7.19e-7)
.MODEL RDSMOD RES (TC1 = 5.45e-3  TC2 = 1.66e-5)
.MODEL RSCLMOD RES (TC1 = 1.25e-3  TC2 = 17e-6)
.MODEL RVTOMOD RES (TC1 = -5.15e-3  TC2 = -4.83e-6)
.MODEL S1AMOD VSWITCH (RON = 1e-5  ROFF = 0.1  VON = -5.25  VOFF= -3.25)
.MODEL S1BMOD VSWITCH (RON = 1e-5  ROFF = 0.1  VON = -3.25  VOFF= -5.25)
.MODEL S2AMOD VSWITCH (RON = 1e-5  ROFF = 0.1  VON = 0.56  VOFF= 5.56)
.MODEL S2BMOD VSWITCH (RON = 1e-5  ROFF = 0.1  VON = 5.56  VOFF= 0.56)

.ENDS
```



NOTE: For further discussion of the PSPICE model, consult **A New PSPICE Sub-Circuit for the Power MOSFET Featuring Global Temperature Options**; written by William J. Hepp and C. Frank Wheatley.

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SPM™
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